I.J. Modern Education and Computer Science, **2018, 2, 54-62**
Published Online February 2018 in MECS (http://www.mecs-press.org/)
DOI: 10.5815/ijmecs.2018.02.07

An Effective Technique to Decline Energy Expenditure in Cloud Platforms

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Received: 08 July 2017; Accepted: 08 August 2017; Published: 08 February 2018

***Abstract*—**The cloud computing is the rapidly growing technology in the IT world. A vital aim of the cloud is to provide the services or resources where they are needed. From the user's prospective convenient computing resources are limitless thatswhy the client does not worry that how many numbers of servers positioned at one site so it is the liability of the cloud service holder to have large number of resources. In cloud data-centers, huge bulk of power exhausted by different computing devices.Energy conservancy is a major concern in the cloud computing systems. From the last several years, the different number of techniques was implemented to minimize that problem but the expected results are not achieved. Now, in the proposed research work, a technique called Enhanced - ACO that is developed to achieve better offloading decisions among virtual machines when the reliability and proper utilization of resources will also be considered and will use ACO algorithm to balance load and energy consumption in cloud environment. The proposed technique also minimizes energy consumption and cost of computing resources that are used by different processes for execution in cloud. The earliest finish time and fault tolerance is evaluated to achieve the objectives of proposed work. The experimental outcomes show the better achievement of prospective model with comparison of existing one. Meanwhile, energy-awake scheduling approach with Ant colony optimization method is an assuring method to accomplish that objective.

***Index Terms*—**Task Scheduling, Energy, Cost, ACO, Cloud Simulator.

I. Introduction

Cloud computing is a very rapidly growing technology today. Cloud computing provides its users to access the various cloud services and enables them to access the data storage and the computational resources with low data overhead. Cloud computing is rapidly growing so it has attracted the users to cloud. It offers its users to outsource the data resources from the remote locations when they need them. The cloud computing is fabricated of certain elements: The cloud clients, main datacenter and dispersed servers.

A. Clients

The cloud clients are, in a cloud computing framework, are commonly, the computers or machines that just lie on the counter. Although they can also be client laptops, consumer tablets, the mobiles,—all enormous operators for cloud as a result of their flexibility. Cloud clients are the equipments that the users communicate with them to maintain their data securely on the cloud platform.

B. The Data-center

The data-center is the assemblage of server machines which contain the application to which you want to sign up is stored. It may be a big area in the subbasement of your home where you can acess the web. A spreading tendency in the information technology world is virtualizing server machines, so that the software's can be equipped by permiting different existences of virtual server machines to be adopted. By using that approach, you can use half of a dozen virtual server machines working on same real servers [4].

C. Dispersed servers

These servers provide the service holder much more adjustability in the options and security concerns. For eg. The Amazon has strong cloud quick fix in server machines in all beyond the world. So if something inexact is happened at one site, inducing a breakdown or error, the service can be accessed over other side [4].

D. Cloud Computing Service Models:

Cloud has a broad collection of services available and organizations and the cloud users can choose these services whenever they want based on how they want to use these cloud services. Cloud computing platform has three types of services and these are: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). These are also known as cloud services models [5]. The cloud can be classified in three specific models. The three service models in cloud infrastructure are given below in detail.

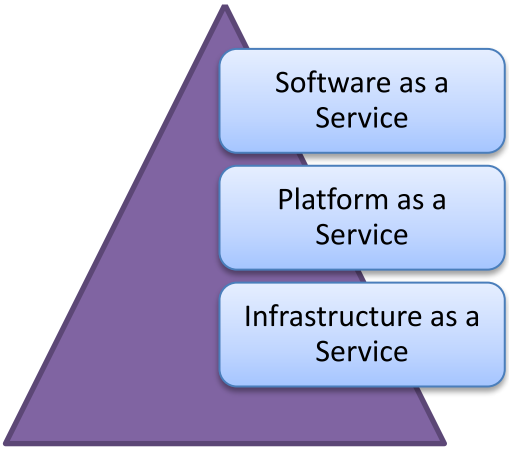

Fig.1. Cloud Computing Service Models

From the last several years, the increased growth of the cloud also maximizes the number of cloud data center at unrivalled speeds. In the intervening period of time, the energy expenditure by the data centers has kept increasing at higher rates. In cloud data-centers, huge bulk of power exhausted by different computing devices.Energy conservancy is an major concern in the cloud computing systems because it provides several important benefits such as diminishing operating costs, improves system accuracy, improve resource utilization, and environmental preservation. Therefore, the focus of cloud resource fulfillment and task scheduling has switched from performance to power efficiency.

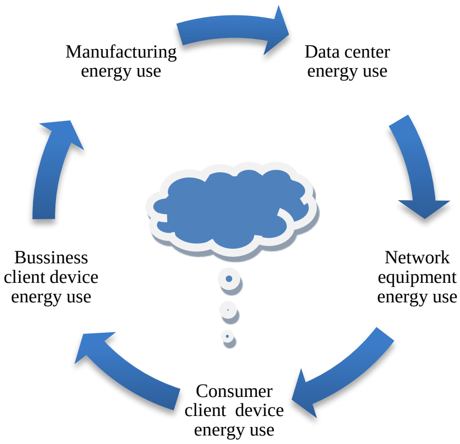

Fig.2. Energy Consumption in Cloud

The other issue in cloud is called load offset that is a critical problem that becomes a big hurdle between the speedy developments of the cloud computing. The various number of users from the distinct regions demands services at high frequency in every individual second from cloud service provider [5]. Meanwhile, energy-awake scheduling approach with Ant colony optimization method is an assuring method to accomplish that objective [6]. The researcher M.Dorigo and his companions popularized the ACO is based on the exploring strategy of various ants that accelerated them through search the best shortend pathway from their home to foodstuff in 1990's. The Macro Dorgio was the first to study about the ant behavior for computing algorithm design and further developed the ant province optimization method for the excellent solutions. When all pests are alter from their home to foodstuff, all pests has the capability to discover an best path from home to foodstuff.Although when pests moving on the way they drops a chemical stuff called metaphores on all the pathway.Pathways are incidentaly selected by the ant at the beginning.While an confined pest encounter formerly locate on routes, then the pest can reveal the pathway and conclude with higher chances to persue it.Higher rich metaphores guides a pest to select the route and maximum of pests are more fascinate because of the higher metaphore.Hence, the trail is strengthen with their owned metaphore.The chances of a pest can deseperate the finest excellent solution in distinction to various distinctive combination of solutions is percentage to the concentration of a pathway of metaphore[11]. The ant colony algorithm is the swarm intelligent algorithm influenced by the behavior of the real ant relations in the ant colonies. A collaboration of the ants in the finding the food and doing other tasks has been prioritized to achieve the ant colony behavior in the computing environments. The ants store the chemical pheromone for the path devising and following while taking a movement from nest to the source of food. With the raise in the number of the ants on a singular path, the strength of the pheromone increases on that particular path. The ants of that colony select the shortest path on the basis of this pheromone amount or value. The ant province optimization method has been applied for resolving the problem of travelling salesman or other problems where the shortest path is needed.

In the proposed work the Enhanced- ACO is used to balance load and minimize energy consumption in cloud in least possible cost. In the proposed work the VM load and failure rate has been assigned as the main parameters to take the scheduling decisions using ACO. Both of the parameters has been used for the purpose of task scheduling over the given cloud resources. The virtual machine load is the parameter which defines the overall utilization of the resources of the given virtual machine.

II. Related Work

L.D. Dhinesh, P. Venkata et al. (2013) the author proposed the algorithm named Honey bee behavior Algorithm to balance load in cloud environment. The proposed model worked on the basis of priorities of tasks on the VM's to Minimize the waiting time of the tasks .In the proposed technique The tasks are removed from the overloaded VM's .the VM's will acts as Honey bees And submits the tasks to the under loaded VM's. Whenever the cloud service provider receives any high priority task it has to submit to that VM, that have minimum number tasks for execution. The all VM's are scheduled in ascending order and the tasks removed from the VM's are submitted to the under loaded VM's. The current load of all VM's can be calculated based on the information received from the cloud datacenter [15]. S.K. Dhurandher et al. (2014) introduced a dispersed batch-based method that accomplishes effective load offsets in the cloud. The prospective method represents feature like supports assortment, scalability, low network bottleneck and vacancy of each blockage link because of it are disperse essence, and designed for multiple masters and multiple servers. In the prospective architecture, links are arranged as a batch of sub batches. The internetwork is partitioned into batches using Batch alike method however each node in the internetwork correspond to absolutely one batch and a retainer is the computation component of the inter network. The prospective method is addressed on a huge extent to cloud data-centre, to evaluate the proposed heuristic CloudSim toolkit used as simulation framework. The analysis is completed at the different criterion: load circulation on data-centres in the cloud, no of processes executed and moderate alteration time for completion of jobs [24].V.S Kushwah, S. K Goyal, P. Narwariya et al. (2014) the author proposed that flaw in the cloud filigree is a typical concern although offsets load. Although to subdue the failure, various different methods for fault tolerant are utilized. The Cloud gain unlock to a brand-new vista for usage of assets. Hence, conveniences of the cloud upgrades of the utmost relevant constituents that are envisage and facilitate the existence of the assests and offsets load. Failure resistance is a concern to treat with although facilitates QoS in a cloud, so strengthening the achievement [24].Nidhi Bansal et al. (2015) the authors have worked upon the cost performance optimization based upon the QoS driven tasks scheduling in the cloud computing environments. The authors have focused upon the cost of the computing resources (virtual machines) to schedule the given pool of the tasks over the cloud computing model. The cost optimization has been performed over the QoS-task driven task scheduling mechanism, which did not encounter the cost optimization problem earlier. The authors have shown that the earlier QoS-driven task scheduling based studies has been considered the make span, latency and load balancing. The QoS-based cost evaluation model evaluates the resource computing cost for the scheduling along with the other parameters as in their secondary precedence. The authors have been proved the efficiency of the proposed model in the terms of the cost, and resource utilization [11]. S. K Goyal, M.Singh et al. (2012) proposed a new technology that is grid computing involve conjoin and correlated usage of topographically dispensed assets for motivation like huge- scale estimation and dispensed information investigation. Although to achieve the client assumptions in provision of execution and efficiency, the grid system needs appropriate and effective workload offset method to parallel circulate the workload on every computing knob in the network. However, to resolve the load offset issue in computational framework, the author represents the Ant Province Optimization method. Although in the prospective technique, the metaphore is corresponding to assests required for execution, preferably than way. The minimum and maximum of metaphore shows the workload and relies upon process status at assests. So the focused aim of the prospective technique is to assign processes to assests in such a way that offset out the workload results in increased usage of assets [22]. N. Kumar, R. Rastogi et al. (2012) the author worked upon the ACO for load balancing of nodes. It is best case for effective balancing load, because in preceding work ant can move in only one direction. But in this algorithm an ant can move forward direction and backward direction. Such as an ant searches the food is called forward direction and homecoming to the nest is called backward direction. This is favorable for balanced the node speedily. This algorithm work fast because an ant can pass simultaneously in both directions for balanced the node and this algorithm also gives the superior usage of assests. The algorithm is performed on the limited parameters suchlike acceleration, internetwork overhead and failure resistance strength [25].

R. Mishra et al. (2012) introduced a solution for load offsets in the cloud platforms. The workload can be centre processing capacity (CPU), internal-memory size or internetwork workload. Load Offset is the methodology of spreading the workload beyond miscellaneous links of a system to expand both assests usage and task feedback time although also escapes a condition in which any of the knobs are densely under loaded and other knobs are unavailable. Load balancing make sure that each knob in the internetwork does relatively the same volume of effort in any interval of time. Various techniques to reconcile this issue has been appear into presence alike PSO, Mix hash technique; GA and different organization based method are there in use. In the prospective work author proposed a technique relies upon Ant province optimization to reconcile the issue of workload offset in the cloud environment. But this method does not deal with the fault resistance concerns [26].

III. Experimental Design

As per the literature survey, it has been found that the load balancing and energy expenditure is an crucial issue in cloud environment, and researchers are giving more consideration towards it so that the proper usage of resources can be done as well as improve the cloud performance with low energy consumption. Processing of computing nodes is done remotely in most of the real time cloud applications. Hence, there is an enlarged necessity for failure province to attain reliability on cloud infrastructure. Researchers have proposed various techniques based on Genetic algorithm, ACO, etc. for workload offset strategy in the cloud environment.

Now**,** In the proposed research work, a technique called Enhanced - ACO that is developed to achieve better offloading decisions among virtual machines when the reliability and proper utilization of resources will also be considered will use ACO algorithm to balance load and energy consumption in cloud environment. The algorithm fully depends upon the history of the pheromone value to take the further judgments for optimal solutions for any of the computational requirement. The use of artificial ants for the state of development rule for the selection of the optimal resources beyond the grid computation or the cloud environments has been proposed in the prospective work. The artificial ants have been used for the purpose of cloud computing scheduling and shortest path identification. The ant province system adopts the arbitrary -proportional rule, which is the state of transition rule used for the ant system and works on the basis of the probability or a chance to choose the optimal resource out of the k-resources for the task assignment in the cloud. The pheromone value of the resource depends upon the number of available resources, processing cost and estimated time.

The proposed model is aimed at solving the problem of the scheduling in the cloud platforms using the Cloud simulator. The process sequencing is a scheme of put the runtime processes in the memory in the perfect placement or sequence in order to minimize the total tasking and communication overhead in terms of time and load respectively. The proposed technique also minimizes energy consumption and cost of computing resources that are used by different processes for execution in cloud. The earliest finish time and fault tolerance is evaluated to achieve the objectives of proposed work. The experimental outcomes show the better achievement of prospective model with comparison of existing one.

This system is fully based upon the J.L. Deneubourg's system based on argentine ants as the ant colony optimization, where the author have laid the pheromone trail on the straight and return path of the ants from the foodstuff source to the home. Although straight path has been examined by the use of VM availability and VM load, whereas the return path continuously updates the pheromone amount with each task assignment. This mechanism keeps the current data in the memory, which leads towards taking the correct decision for the optimal path planning for the task scheduling over the cloud environments. Figure 4.2.1 shows the two joins and the mathematical formula is given in equations (1) and (2).

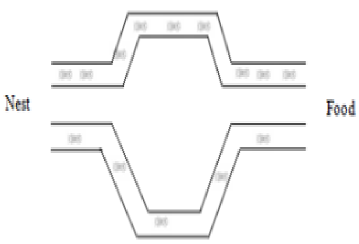

Fig.3. Mathematical Formula for ACO algorithm

$$Prob_A = \frac{(K+A_i)^n}{(K+A_i)^n + (K+B_i)^n} \quad (Prob_A + Prob_B = 1) \tag{1}$$

$$A_{i+1} = A_i + \delta,\ B_{i+1} = B_i + (1-\delta)\ \ (A_i + B_i = i) \tag{2}$$

Where δ is the stochastic binary variable which contains the value of either 1 or 0 assigned on the basis of the multiple probability levels (ProbA and ProbB). A is the first path moving towards the food source, which is incremented with the entry of every new ant on the path with the pheromone A and value B is incremented with 1 if the ant chooses the path B. The probabilities are rising with the span of time, which depicts the pheromone amounts.

Algorithm: Enchanced Aco Algorithm

1. The input parameters for the ant colony optimization method are initialized.
2. The available VMs are thoroughly checked over the cloud computing environment.
3. The available VM list is loaded into the runtime memory with the RAM and CPU details.
4. The available resource list is updated with the VM list prepared on the step 3.

$$VM_1 = \{V_1, V_2, V_3, V_4 \ldots\ldots\ldots\ldots V_n\} \tag{3}$$

where VM is the virtual machine list and V_1 to V_N to represent the virtual machine IDs.

5. The resource capacity is calculated for each resource and has been given as the following list:

$$VM_R = \{VM_1, VM_2, VM_3, VM_4 \ldots\ldots VM_n\} \tag{4}$$

6. Loop is started for every resource Read and load the available resources on each VM and update the resource list with current values.

$$VM_E = \int_{i=1}^{N} VM_i \tag{5}$$

where VM_E gives the resource availability after calculating the resource load.

$$L = \frac{VCPU_u}{VCPU_T} \tag{6}$$

Where L represents the overall resource load on the particular VM, whereas the $VCPU_u$ and $VCPU_T$ gives the currently used resources and total resources available respectively.

7. End the loop on step 5
8. Load the task list into the runtime memory.

$$T = \{t_1, t_2, t_3, t_4 \ldots\ldots\ldots t_n\} \tag{7}$$

Where T vector represents the task vector and t_1 and t_n represents the individual tasks.

9. Calculate the length of the tasks in the form of earliest finish time to calculate the length of the each individual task.

$$t_c(t_i) = (Eft - Est) \quad (8)$$

Where t_c and t_i gives the overall time length of each of the task by subtracting the estimated start time from estimated finish time.

10. Subdivide the each task j and create the sub-task list where each sub-task is assigned with i
11. Scheduling iterations are initialized for the number of tasks or sub-tasks with i.
12. Calculate the probability value of each available VM.
13. Compare the task length with probability value and resource usage on all available VMs.
14. Calculate the VM Load in the form of resource usage percentage using the following formula, where Aj depicts the availability of the VMs.

$$A_j = P_j * TR_i \quad (9)$$

15. Calculate the failure rate of all VMs to determine the trustworthy VMs to assign the current task.
16. Shortlist the list of available VMs which can process the given task i.
17. Assign the task i to the resource with minimum response time and highest probability.
18. Update the resource list with the current values of VM load
19. Update the pheromone value for each available resource.
20. End the iteration and process the tasks.

IV. Results and Discussions

The proposed model simulation has been prepared by using the Cloud Simulator for the task scheduling procedure testing over the virtual cloud environment. A scenario of multiple user online source has been assumed in this simulation, where the request are being received from the multiple users on same time as per it happens in the social networks like Facebook, Twitter or other online giants such as Google, Amazon, etc. The VM regions has been defined according to the failure rate and virtual machine load status which is transformed into the threshold value using the mathematical equations. Entire simulation is based on the single Time zone scenario, where all users in the given user base are projected as residents of one country or time zone. The simulation can be easily considered for the testing in the peak hours for the point of task scheduling of the samples tasks over the given bunch of resources. The task density has been assumed to be overwhelming during the peak hours, which delays the request response by adding the scheduling delay or processing delay. Hence, the task scheduling method should be enough faster to reduce the task scheduling delay and assigned resources should be enough vigorous to process the task as fast as possible to minimize the processing delay.

The design of the prospective technique can be defined in the form of main modules among the task scheduling procedure. The prospective model can be easily defined in the major four procedure model. The proposed procedure has been designed to attain the task information on the very first step, and then the task cost is calculated by investigating the task length and volume of data associated with the task. Afterwards, the number of available virtual machines (VM) is evaluated for their usability. The usability of the available virtual machines is predicted on the basis of their resource usage. The task cost and the VM availability are evaluated in the terms of resource usage and elapsed time. The VM offering the least time of the task is selected for the task execution.

The VM load and failure rate has been assigned as the main parameters to take the scheduling decisions. Both of the parameters has been used for the purpose of task scheduling over the given cloud resources. The virtual machine load is the parameter which defines the overall utilization of the resources of the given virtual machine. The VM load can be used to signify the runtime availability in order to process the given task t on the given time t. The tasks running over the given VM utilize the certain amount of resources. The total percentage of the resources being used during the time t is considered as the VM load.

When the virtual machines are ordered in the workload allocation pool for the process sequencing in the given cloud environment, the load monitoring on each virtual machine becomes very important step to correctly perform the task scheduling tasks. The virtual machine load or overhead is calculated on the base of different parameters like as CPU size, memory size, etc. Each VM load must be calculated on the basis of its local parameters. Any use of general parameter values can result the biased load over the given VMs. The CPU and Memory overhead or usage on the given VM considerably influences the performance of the VM's in the process sequencing practices.

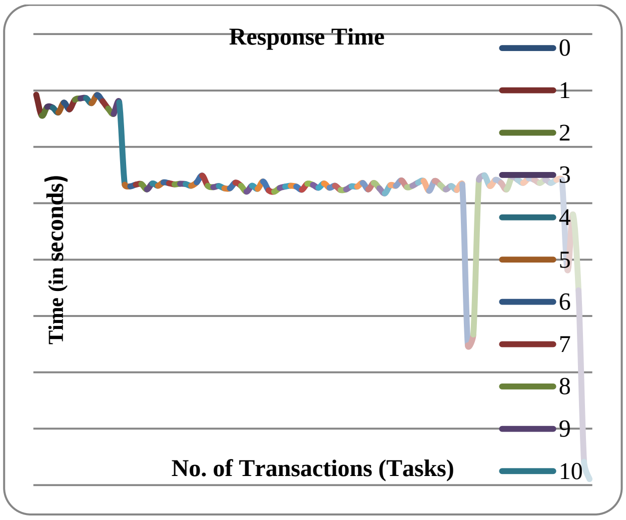

Fig.4. Response time per task or transaction

Fig. 4. The response time describes the total time taken for the cloud platform to generate the reply to the user's request. The proposed model has been evaluated for the results obtained from the simulation for the response time, which has been represented graphically in the following figure. The overall response time of process 100 is 0.21 seconds. The response time for process 1 is 13.11 seconds and for process 99 the response time that is 0.83 seconds. The process 8 takes 6.91 seconds to complete the task.

Fig. 5. The energy consumption has been also monitored for each of the task in order to assess the overall energy consumption during the simulation. The proposed model has been designed to schedule to task over the virtual machine with the minimum energy and cost indices. The following figure shows the overall energy consumption for all of the tasks in the simulation. The process 100 consumes 0.1239joules of energy to complete the execution. The process 99 consumes 0.4897 joules of energy to complete the execution. The following figure shows the energy consumed by every individual process to complete the execution in the proposed system.

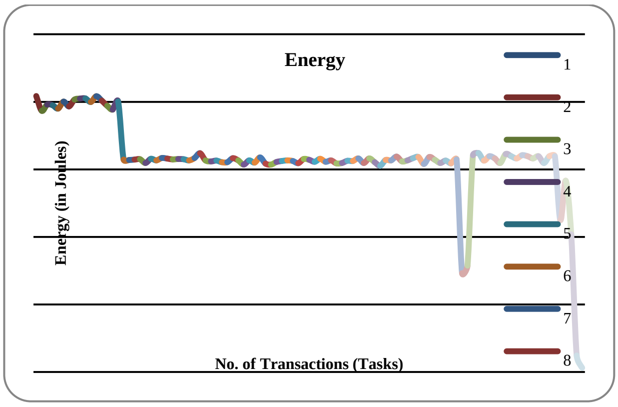

Fig.5. Energy consumption per task or transaction

Fig. 6. The proposed model has been compared on the basis of response time, which is one of the primary performance indicators for the cloud computing models. The task scheduling models are expected to return the minimum values of response time in order to handle the maximum number of users every second.

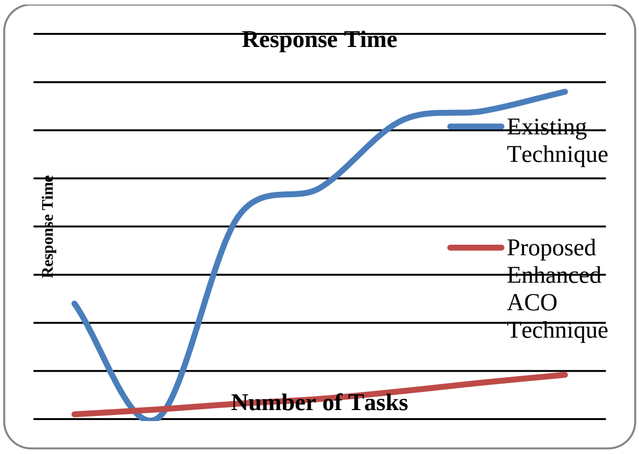

Fig.6. Graphical Representation of the Response time in seconds

In this comparative model the proposed model has worked expectedly, and consistently shows the robust performance by reducing the response time in comparison with the existing model.

Fig. 7. The imbalance degree of the proposed model has been found lower than the existing models, which shows the robustness of the proposed model in handling the multiple tasks (in workflows). The proposed model has found more successful in even distribution among the given resources (VMs), than the existing model.

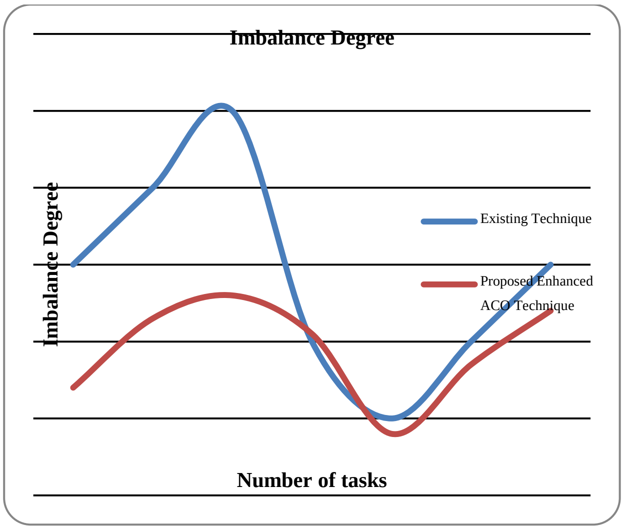

Fig.7. Graphical Representation of the imbalance degree

The proposed model has clearly outperformed the existing model on the basis of the imbalance degree in comparison with the honey bee based existing model. The proposed model has performed better in nearly all of the events assigned with different number of tasks during the experimental study.

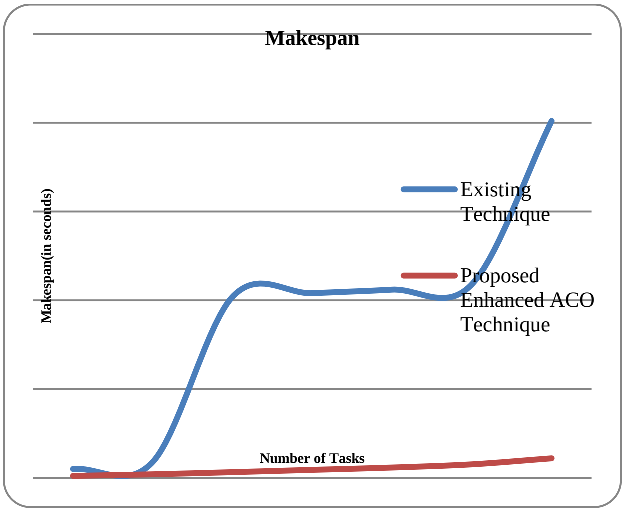

Fig.8. Graphical Representation for the Make span

Fig. 8. The proposed model based upon the ACO based task scheduling has been compared against the Honey bee algorithm in the existing scenario. The figure 5.3 shows the robustness of the proposed model is comparison with the existing model. The make span has

been recorded significantly lower in the case of proposed scenario in comparison with the honey bee algorithm based existing scenario.

The proposed model has been found efficient with the lower reading than the existing model.

V. CONCLUSIONS

The cloud computing environments with larger number of user bases are always remain the difficult task to assign the task to the most suitable resources. The most suitable resources consideration can be stated for the resource with the powerful configuration to process the given tasks with quickness and accuracy. The virtual machines are considered as the resources for assigning the tasks in the form of user request and internal system data call and queries. The task assignment becomes the critical job when millions of queries or tasks are coming to the cloud platform from its users. The task assignment or resource scheduling can be categorized according to more number of tasks in less time, critical tasks first, low cost computing resources or any of the combination of these three. In this paper, we have worked upon solving the problem of processing the maximum number of tasks every second, which can definitely enhance the user satisfaction. Also the proposed model is aimed at assigning the resources (VMs) with least resource load and failure rate for the task pool. The virtual machine wills lowest possible load and lowest failure rate will be carrying high probability to reduce the overall time of task and to process it successfully that will also minimizes the amount of tasks in the waiting list. The prospective method results has been compared to the existing models with ACO based load balancing mechanism, GA, SHC and FCFS. The proposed model results have proved to be efficient enough while compared to the existing models for the cloud task processing. The results have obtained and analyzed in the terms of start time, finish time and response time. The experimental results have verified the effectiveness of the prospective system in scheduling and processing the tasks successfully over the given cloud resources.

FUTURE SCOPE

In the future, the resource scheduling method can be improved by using the probabilistic mechanism by using the failure rate, current load, average load and other resources properties. The probabilistic mechanism calculates the probability of the successful transaction for the given task, which ensures the correct resources allocation to maximize the success rate and to minimize the failure rate. An adaptive threshold can be computed to discard the virtual machines with higher failure rate than the threshold can be refused from the available resource list to process the critical tasks. The gray wolf optimizer (GWO) may possibly upgrade the performance of the task scheduling process in contrast with the ant colony optimization (ACO) in our system. The proposed algorithm offset the load in cloud and improves the overall performance of cloud environment. This algorithm considers Response time, energy as the major QoS parameter. In the future, the algorithm will be improved by examine other QoS parameters and also contrast the result of the proposed algorithm with new algorithms.

ACKNOWLEDGMENT

I acknowledge with deep feel of obligation and most trustworthy recognition, the helpful guidance and bottomless assistance rendered to me by “Dr. Bikrampal Kaur” Professor for their experienced and concerned guidance, useful assistance and enormous help. I have been deep sense of praise for them convict goodness and infinite passion. The proposed work will be finished under the guidance of the official guide and other experts at the campus of the Chandigarh group of Colleges, Landran, and Mohali.

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How to cite this paper: Anureet A. Kaur, Bikrampal B. Kaur, " An Effective Technique to Decline Energy Expenditure in Cloud Platforms", International Journal of Modern Education and Computer Science(IJMECS), Vol.10, No.2, pp. 54-62, 2018.DOI: 10.5815/ijmecs.2018.02.07

